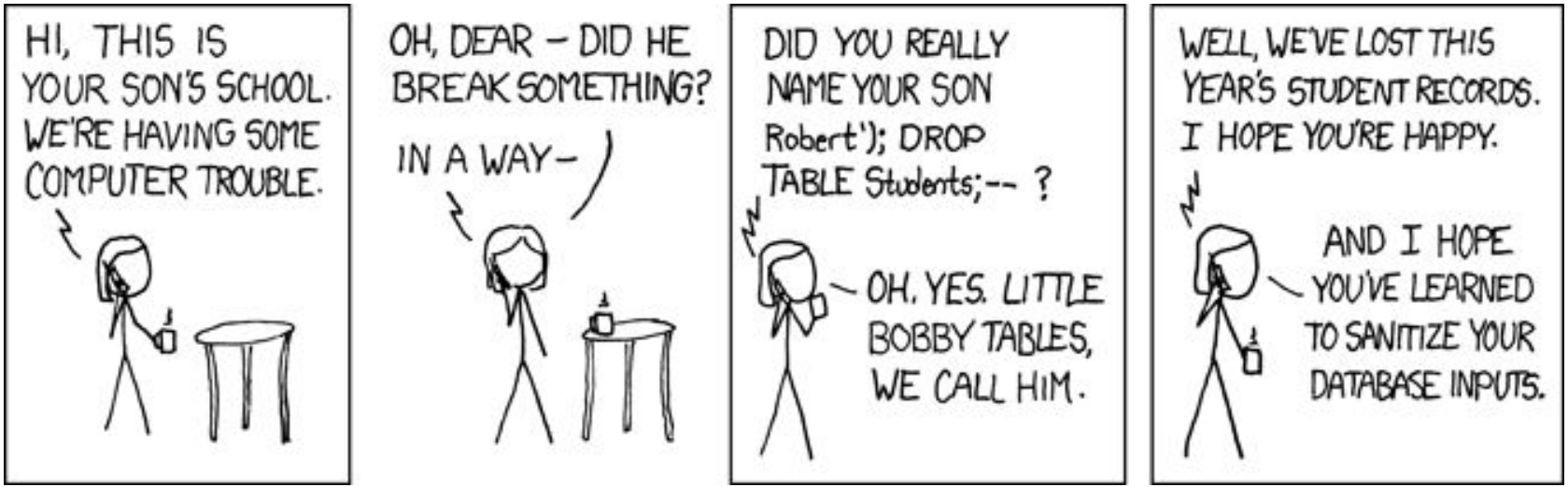
Module 2 - Lecture 9

Data Security

REVIEW

- What is Integration Testing?
- What are 3 attributes of a good test?
- Where to host the database?
- What to do with the data to enable independence & repeatability?


HI, THIS IS YOUR SON'S SCHOOL. WE'RE HAVING SOME COMPUTER TROUBLE.
OH, DEAR – DID HE BREAK SOMETHING?
IN A WAY–
DID YOU REALLY NAME YOUR SON Robert'); DROP TABLE Students;-- ?
OH. YES. LITTLE BOBBY TABLES, WE CALL HIM.
WELL, WE'VE LOST THIS YEAR'S STUDENT RECORDS. I HOPE YOU'RE HAPPY.
AND I HOPE YOU'VE LEARNED TO SANITIZE YOUR DATABASE INPUTS.

SQL Injection Attacks

Practice Safe Computing

- **Parameterized queries**: when done consistently, SQL injection attacks will not be possible.

- **Input validation**: limit the number of acceptable values.

- **Limit database user privileges**: the user that your application is accessing your database with should be given the least permissions necessary to function. This is called *Principle of Least Privilege*.

Securing Passwords / Secrets

Securing Passwords / Secrets

- We need to be able to verify a password, not see the password.
- A system administrator with full access to the credential database should not be able to see your password.
- A hacker that stole the credential database should not be able to see your password.
- Even with supercomputing power, no one should be able to uncover the data in a reasonable amount of time.

HASHING

HASHING

- A one way function to obfuscate the data.
- This is used prior to storage of the password.
- To verify the password, the same function is used to re-generate the hash and that is what is compared against the database.
- Passwords should also be salted prior to hashing. This will make it take even longer for someone to crack.

What makes a good hashing function?

- Inputs and outputs are constrained
- Relationship between inputs and outputs appears random
- Inputs should be evenly distributed over outputs
- Some degree of efficiency that does not sacrifice collision resistance
- Examples of hashing functions:
  - Message Digest **(MD5 - cracked via Birthday Attack)**
  - Secure Hash Algorithm **(SHA-512)**

ENCRYPTION

Securing data at rest

- Data at rest can use a form of encryption called **symmetric key encryption**. Symmetric because the key works for both encrypting and decrypting.

- Requires both parties to use the key to encrypt and decrypt data.

- Any party possessing the key can read the data.

- Has difficulties of securing the symmetric key amongst multiple parties.

Securing data in transit

- Data in transit is often secured using **asymmetric encryption** or **public key encryption**.

- Asymmetric algorithms allow us to create a **public key** and a **private key**.
  - The public key is distributed freely.
  - The private key is kept to ourselves.

HTTPS & SSL/TLS

- TLS and SSL are recognized as protocols to provide secure HTTP(S) for internet transactions.

- What are Digital Certificates?

- What is a Man-in-the-Middle Attack?

- High-level, how is data secured during a web-browsing session?

Open Web Application Security (OWASP)

1. Broken Access Control
    - Path traversal, enumeration, CSRF, CORS configuration
2. Cryptographic Failures
    - Not using HTTPS, encryption, hashing, or using broken algorithms.
3. Injection
    - SQL injection, XSS, etc
4. Insecure Design
    - Security questions, lack of bot detection/prevention
5. Security Misconfiguration
6. Vulnerable or Outdated components
7. Identification or Authentication failures
    - Missing multi-factor authentication. Don’t allow for weak passwords.
8. Software and Data Integrity failures
9. Security and Logging Misconfiguration failures
10. Server-Side Request Forgery
    - Allowing access to objects or services that the server should have access to, but not the client.

Secure Consumer Practices

- Use lengthy passwords
- Never repeat your passwords
- Use a password manager
- Be weary of security questions

- Use multi-factor authentication, especially on your most critical accounts
  - Your email account is very critical

- Do not trust websites that are not using HTTPS

- Upgrade software to get latest security updates

- Backup your data

- Use Anti-Virus & Firewall protections

- Avoid Phishing

QUESTIONS?